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PATENT
Docket No. **LS/0002.00**

OIPE APR 1 4 2003 PATENT & TRADEMARK OFFICE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:	
Venkat Easwar et al.	Examiner: Nguyen, L.
Serial No.: 09/489,511	Art Unit: 2612
Filed: January 21, 2000	APPEAL BRIEF
For: Improved Digital Camera Device with Methodology for Efficient Color Conversion	

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Sir:

BRIEF ON BEHALF OF VENKAT EASWAR ET AL.:

This is an appeal from the Final Rejection mailed September 5, 2002, in which currently-pending claims 1-40 stand finally rejected. Appellant filed a Notice of Appeal on January 10, 2003 (as indicated by return of a confirmation postcard marked "OIPE Jan 10 2003"). This brief is submitted in triplicate in support of Appellant's appeal.

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1. REAL PARTY IN INTEREST:

The real party in interest is assignee LightSurf Technologies, Inc., a California corporation, located at 110 Cooper Street, 4th Floor, Santa Cruz, CA 95060.

2. RELATED APPEALS AND INTERFERENCES:

There are no pending appeals or interferences known to Appellant, the Appellant's legal representative, or assignee which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal. However, Appellant has filed a Notice of Appeal in application serial number 09/434,703, of which the present application is a continuation-in part thereof.

3. STATUS OF CLAIMS:

Claims 1-40 are pending in the subject application and are the subject of this appeal. An appendix setting forth the claims involved in the appeal is included as the last section of this brief.

4. STATUS OF AMENDMENTS:

Two Amendments have been filed in this case. Appellant mailed an Amendment on April 2, 2002, in response to a non-final Office Action dated October 2, 2001. In the Amendment, the pending claims were amended in a manner which Appellant believes clearly distinguished the claimed invention over the art of record, for overcoming the art rejections. Nevertheless, substantial additional effort was put forth in an effort to expedite prosecution of the present application. Appellant's representative engaged the Examiner in a telephone interview and as a result of that filed a second (supplemental) Amendment on June 19, 2002, including still further amendments to the claims in an effort to address all reasonable concerns of the Examiner. Notwithstanding these efforts, Appellant received an Examiner's Final Rejection dated September 5, 2002. Appellant has chosen to forego filing additional amendments to further limit Appellant's claims, as it is believed that further amendments to the claims are not warranted in view of the art.

5. SUMMARY OF INVENTION:

Appellant's invention comprises a digital imaging system providing techniques for reducing the amount of processing power required by a given digital camera device and for reducing the bandwidth required for transmitting image information to a target platform. The system only performs a partial computation at the digital imager device employing an efficient color conversion process, using a GUV color space. After an RGB mosaic (image) is captured, the image is "companded" or quantized by representing it with less bits (e.g., companding from 10 bits to 8 bits). The image is then mapped from RGB color space to GUV color space, using an RGB-to-GUV transformation. In one embodiment, this conversion is deferred until the image is transferred to another device (e.g., server computer).

Once converted into GUV color space, the image may now be compressed, for instance using wavelet transform-based compression, and then transmitted, using wireless or wire-line transfer, to any desired target platform (e.g., desktop or server computer at a remote location). At the target platform, the GUV information may be restored in a non-compressed format and then further processed into a desired representation (e.g., standard format, such as JPEG). In this fashion, the GUV-based methodology avoids the inefficiency of remaining in RGB color space and avoids the computational complexity of converting to YUV color space, yet retains the benefits associated with YUV color space (e.g., de-correlation of image information).

With this approach, the camera-implemented portion of image processing may forego color processing, **including foregoing color interpolation**. Instead of performing compute-intensive tasks, such as color interpolations and YUV transformations (Y representing brightness or luminance, and U and V representing degree of colors -- hue and saturation), the methodology performs trivial color plane separation followed by wavelet decomposition, quantization, and generic binary compression (e.g., run-length and Huffman encoding). The end result is that the amount of processing necessary to go from a captured image to a compressed record of the captured image (i.e., a record suitable for storage on the digital camera) is substantially less than that necessary for transforming the captured image into color and then compressing it into a color-rendered compressed image. Further, the resulting compressed luminosity record, because of its increased compression ratios (e.g., relative to conventional JPEG), facilitates wireless (or other limited bandwidth) transfer of images to target platforms.

6. ISSUES:

The issues presented on appeal are: (1) whether claims 1-6, 22, and 26-30 are unpatentable under 35 U.S.C. Section 102(e) as being anticipated by Acharya (U.S. Patent No. 6,392,699); (2) whether claims 7, 11-14, 17, 31, and 35-38 are unpatentable under 35 U.S.C. Section 103(a) as being obvious over Acharya (U.S. Patent No. 6,392,699) in view of Acharya (U.S. Patent No. 6,348,929); (3) whether claims 8-10, 23-24, and 32-34 are unpatentable under 35 U.S.C. Section 103(a) as being obvious over Acharya (USP 6,392,699) in view of Acharya et al. (USP 6,348,929) further in view of Wang et al. (USP 5,682,152); (4) whether claims15 and 39 are unpatentable under 35 U.S.C. Section 103(a) as being obvious over Acharya (US 6,392,699) in view of Acharya et al. (USP 6,348,929) further in view of Fukuoka (USP 5,754,227); (5) whether claims 16, 18-21, 25 and 40 are unpatentable over Acharya (USP 6,392,699) in view of Acharya et al. (USP 6,348,929) further in view of Rabbani et al. (USP 5,412,427); and (6) whether claims 1 and 26 (and by implication claims 2-22 and 27-40) are indefinite under 35 U.S.C. 112, second paragraph.

7. GROUPING OF CLAIMS:

For purposes of this appeal, Appellant believes that the following groups of claims are separately patentable with respect to the prior art rejections under Sections 102 and 103. Thus, the claims do not stand or fall together with respect to these rejections but are instead grouped as follows:

Group I:	1-6, 22, and 26-30
Group II:	7, 11-14, 17, 31, and 35-38
Group III:	8-10, 23-24, and 32-34
Group IV:	15 and 39
Group V:	16, 18-21, 25 and 40

The reasoning supporting separate patentability of the above groups is set forth in detail below, in the Argument section. (The rejection of the claims under Section 112, second paragraph, is discussed in a separate section below.)

8. ARGUMENT:

A. Rejection under 35 U.S.C. Section 102

1. General

A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in the single prior art reference. (See, e.g., MPEP Section 2131.) As will be shown below, the reference fails to teach each and every element set forth in claim 1, as well as other claims of Group I, and therefore fails to establish anticipation of the claimed invention under Section 102.

2. Group I claims

Claims 1-6, 22, and 26-30 stand rejected under 35 U.S.C. Section 102(e) as being anticipated by Acharya (U.S. Patent No. 6,392,699). Here, the Examiner likens Acharya's integrated color interpolation/color space conversion image processing technique to Appellant's distributed (i.e., non-integrated) image processing approach.

The Examiner's rejection of claims 1 and 26 is representative.

> Regarding claims 1 and 26, Acharya discloses an integrated color interpolation and color space conversion technique and apparatus, comprising receiving an image in a first color space RGB (figure 6, column 1, lines 14-25); while said image is in said first color space, companding the image by mapping the luminosity values captured at said RGB mosaic into a space that is more linear to a human eye (companding module 625, figure 5, column 10, lines 20-25), while deferring any interpolation of pixels until after the companded image has been transferred (color interpolation may be achieved in a software application running on computer system 710 rather than directly in camera 730, figure 6, column 11, lines 58-67); transferring the companded image to a server computer (companded image is transferred to server computer via bus 660, figures 5-6); storing information describing a second color space (color space YCrCb is stored in memory 711 or disk 718, figure 6, column 12, lines 29-31); at the server computer, transforming the image into said second color space, including interpolating the primary channel of second color space, computing the secondary channels of said second color space, including performing substeps of computing one of said secondary channels of said second color space by differencing Red pixels with co-sited Green pixels (different chrominance of Red color, Cr, column 2, lines 62- 67) interpolated from said RGB mosaic, and computing the other of said secondary channels of said second color space by differencing Blue pixels with co-sited Green pixels (different chrominance of Blue color, Cb, column 2, lines 62-67) interpolated from said RGB mosaic (integrated color space

conversion and color interpolation may be achieved in a software application running on computer system 710 rather than directly in computer 730, column 11, line 58 through column 12, line 39, column 6, line 15 through column 7, line 67).

(Examiner's Final Action, paragraph 5)

As will be shown below, Appellant's invention is distinguishable on a variety of grounds.

At the outset, it is worth noting that Appellant does not claim to have invented the general notion of camera-side image processing. Based on the Examiner's Actions to date, the Examiner seems content to merely find examples in the prior art that discuss device-side or camera-side image processing -- examples which leave the nuances of Appellant's invention (and corresponding patent claim limitations thereof) completely unaddressed. To be sure, there are many examples in the prior art of camera-side image processing, of which Acharya is certainly one. However, there are no claims of Appellant that can be construed to somehow cover the broad field of camera-side image processing. Instead of the prior art approach of performing color interpolation at the camera (or image capture device), Appellant's approach is to defer that processing step until the image has been transferred to another device (e.g., desktop computer). Appellant has invented a camera-side image processing technique that forgoes the compute-intensive process of performing color interpolation, but instead pushes that aspect to server-side processing (where compute resources are far more abundant).

Turning now to the specific teachings of the Acharya '699 patent, the reference describes "an integrated **color interpolation** and color space conversion technique and apparatus" (see, e.g.,. Acharya Abstract; emphasis added). Acharya explains further: "It would be desirable to design and provide a technique that integrates the operation of **color interpolation** and color space conversion into a single operation. (Acharya, col. 3, lines 43-46; emphasis added) "Further, in a **digital camera where color interpolation is performed on-camera**, it may be desirable to **also perform color space conversion** in an integrated manner so that the overall computational complexity and time, as well as image memory size can all be reduced." (Acharya, col. 3, lines 49-53; emphasis added) To achieve these goals, Acharya describes (in his Summary section) that his invention is a method "providing an integrated color space conversion **and color interpolation** technique [...] generating therefrom a color

interpolated image in a different color space." (Acharya, col. 3, lines 56-62; emphasis added) It is readily apparent from the outset of examining Acharya, that Acharya contemplates a technique or method that includes color interpolation. More to the point, the particular innovative feature touted by Acharya is that his technique is integrated with color space conversion so that the two can be performed together (with particular efficiency gains realized), and he shows that being done in particular at the camera.

Appellant's invention includes a technique that actively seeks to eliminate or forego color processing, including foregoing color interpolation, upon image capture. In Appellant's first-filed Amendment, Appellant amended the claims to explicitly recite that the claimed approach includes deferring the color interpolation process and Appellant's unique GUV color space transformation until after the image data is transferred (e.g., from a source device, such as a small digital camera) to a server computer. This approach allows the camera to forego resource requirements (e.g., processor and battery resources) that would otherwise be required for performing the traditional device-side color processing, whether it be stand-alone color interpolation process set or an "integrated" color interpolation such as described by Acharya. Quite simply, the approach described by Appellant and set forth in detail in the claims is to eliminate all color interpolation at the capturing device.

This unique feature is not some sort of happenstance raised merely as a point of distinction, but is instead a core feature that served as an impetus for filing the present application. Consider, for example, the following from Appellant's specification.

> A preferred methodology of the present invention for digital image processing includes the following steps. At the outset, an image is captured by a capture process; this may be done in a conventional manner. **Next, however, the color interpolation or transformation process of conventional digital image processing is entirely avoided.** Instead, the sensor image is separated into individual color planes (e.g., R, G, and B planes for an RGB color filter mosaic). Each color plane consists of all the sensor pixels imaged with the corresponding color filter. The color plane separation process requires far fewer machine instructions than the color interpolation and transformation process. The separated color plane information is referred as "luminosity information". Hence as described herein, operations on the "luminosity" image refer to operations applied to the individual color planes in the luminosity image.

(Appellant's specification, at p. 9, lines 12-22; emphasis added)

From p. 9 to 12, Appellant's specification details the particular process steps required to implement a camera-side technique that foregoes color processing (including color interpolation). At the outset, an image is captured by a capture process; this may be done in a conventional manner. **Next, however, the color interpolation or transformation process of conventional digital image processing is entirely avoided.** Instead, the sensor image is separated into individual color planes (e.g., R, G, and B planes for an RGB color filter mosaic). Each color plane consists of all the sensor pixels imaged with the corresponding color filter. The color plane separation process requires far fewer machine instructions than the color interpolation and transformation process. Next, the methodology of the present invention immediately proceeds to coding the luminosity information (i.e., the separated color planes). In a particular embodiment, the present invention applies a wavelet transform process to prioritize information in the luminosity image (i.e., the color planes in the luminosity image are individually wavelet transformed). In contrast to the prior art approach of proceeding to color interpolation and color space conversion (whether performed separately, or in an integrated manner as described by Acharya), the methodology of the present invention skips color interpolation processing and instead immediately proceeds to coding the luminosity information (i.e., the separated color planes). This is followed by wavelet decomposition, quantization, and generic binary compression (e.g., run-length and Huffman encoding).

What Appellant realized is given that digital cameras exist in a highly-connected environment (e.g., one in which digital cameras usually transfer image information to other computing devices), there is an opportunity to take advantage of other processing power that is eventually going to come into contact with the images that are produced by the digital imaging device ("imager"). More particularly, there is an opportunity to defer and/or distribute the processing between the digital imager itself and the target platform that the digital imager will ultimately be connected to, either directly or indirectly. The approach of the present invention is, therefore, to decrease the actual computation that occurs at the digital imager: perform a partial computation at the digital imager device and complete the computation somewhere else -- somewhere where time and size are not an issue (relative to the imager). By "re-architecting" the digital camera to defer resource-intensive computations, the present invention may substantially reduce the processor requirements and concomitant battery requirements for digital cameras. Further, the present invention adopts an image strategy which reduces the bandwidth

requirements for transmitting images, thereby facilitating the wireless transmission of digital camera images.

Turning now to Appellant's rejected claims, independent claim 1 recites claim limitations including:

receiving an image in a first color space from an RGB (Red, Green, Blue) mosaic, said image including luminosity values captured at said RGB mosaic, said first color space including primary (Green) and secondary (Red, Blue) channels;

<u>while said image is in said first color space, companding the image by mapping the luminosity values captured at said RGB mosaic into a space that is more linear to a human eye,</u> **<u>but deferring any interpolation of pixels until after the companded image has been transferred</u>**;

<u>transferring</u> <u>the companded image to a server computer</u>;

storing information describing a second color space, said second color space including primary and secondary channels, said primary channel of said second color space corresponding to the primary channel of said first color space; and

<u>at the server computer, transforming</u> <u>the image into said second color space</u>, including:

interpolating the primary channel of said second color space to full resolution by interpolating missing Green pixels from said RGB mosaic, and

computing the secondary channels of said second color space as differences from the primary channel of said second color, including performing substeps of:

(i) computing one of said secondary channels of said second color space by differencing Red pixels with co-sited Green pixels interpolated from said RGB mosaic, and

(ii) computing the other of said secondary channels of said second color space by differencing Blue pixels with co-sited Green pixels interpolated from said RGB mosaic.

Independent claim 1 explicitly recites that the claimed approach includes <u>deferring</u> the interpolation process and color space transformation until <u>after</u> the image data is transferred (e.g., from a source device, such as a small digital camera) to a server computer. (Rejected independent claim 26 includes similar claim limitations.) This approach allows the camera to forego color processing and color interpolation (and concomitant resource requirements thereof) that would otherwise be required for performing the traditional device-side processing, such as would be required to implement Acharya's integrated color interpolation/color space conversion.

Turning now to the specific logic underlying the Examiner's position, the Examiner has at best grafted Appellant's invention onto the hardware of Acharya while at the

same time ignoring explicit teachings of Acharya. Consider, for example, the Examiner's statement that the aspect of deferring any (color) interpolation of pixels until after the companded image has been transferred is met by: "color interpolation may be achieved in a software application running on computer system 710 rather than directly in camera 730, figure 6, column 11, lines 58-67)" (Examiner Action, paragraph 5). Regarding Acharya's computer system 710, Acharya states that color interpolation is performed at the camera, as is explicitly illustrated by Acharya in his Fig. 6 and accompanying description. For example, Acharya states at col. 11, at line 21, "Essentially, captured images are processed by an image processing circuit 732 so that they can be efficiently stored in an image memory unit 734, which may be a ROM, RAM or other storage device such as a fixed disk." As shown in Fig. 6, image memory unit 734 is physically housed within the camera 730. Further, Acharya states at line 25, "The image contained within image memory unit 734 that is destined for computer system 710 can be according to one embodiment of the invention, stored directly as a 12-bit YCrCb image space as opposed to an 24-bit color interpolated RGB image space." Here, Acharya is explicitly indicating that the image in the YCrCb image space (i.e., has already undergone integrated color interpolation/color space conversion) is stored in the image memory unit 734 of the camera 730.

Acharya gives additional indication in the '699 patent that his teaching pertains to performing his integrated color interpolation/color space conversion technique at the camera. For instance, after the above-cited description that Acharya provides for his Fig. 6, Acharya continues:

> The invention in its various embodiments, particularly in providing a **12-bit YCrCb image that is directly converted from the captured 8-bit Bayer pattern, reduces the storage requirements of the camera 730** and thus, the costs associated with that storage allowing for a more inexpensive camera.
>
> (Acharya, column 11 , lines 32-37.)

These explicit teachings leave no doubt as to where Acharya had contemplated performing color interpolation. The Examiner's position that Acharya provides a base reference for teaching some sort of distributed image processing that expressly defers color interpolation (as required by Appellant's claims) directly contradicts what Acharya really taught.

Still further, to the extent that Acharya teaches the <u>integration</u> of color interpolation with color space conversion (i.e., performed as a single, integrated process) at the imaging device or camera, Acharya clearly teaches away from Appellant's claimed approach of removing the color interpolation process step from the device-side image processing altogether, in recognition that that compute-intensive process step could be performed by another device downstream (e.g., server computer to which images are uploaded for photofinishing services). All told, the Examiner has not only had to apply Appellant's own invention to Acharya's hardware in an effort to re-create Appellant's invention, but the Examiner has had to take the additional step of ignoring Acharya's own teachings which are hardly silent as to where color interpolation is performed. In particular, the teaching that color interpolation may be deferred after the image (e.g., companded image, as set forth in independent claims 1 and 26) has been transferred to another device (e.g., server computer) is lifted directly from Appellant's specification but finds no support whatsoever in Acharya.

There are other differences as well. In Appellant's claimed invention, the destination color space is preferably GUV, not YUV. It turns out that the Green plane is where one observes most of the luminosity information. Accordingly, the Green plane is the most important plane for image perception by the human eye. For instance, the G (Green) component receives the largest weighting when determining chrominance (Y).

```
Y = 0.301R + 0.586G + 0.113B
```

<u>To avoid the expense of converting to the Y plane</u> (which entails, besides additional multiplication and addition operations, the expense of interpolating R and B values at each given location), the G plane is therefore instead employed in the color space of Appellant's invention. The Examiner has simply addressed this in passing by stating stating that the element is met by the color space YCrCb. (See, e.g., Examiner's Final Action, at paragraph 5.)

In Appellant's approach, transforming to GUV color space entails the computation of the following color values per cell, G0, G1, G2, G3, U, V (i.e., a single U and V for a cell):

```
G0 = (Ga+Gb+G1+G2)/4
G3 = (G1+G2+Gc+Gd)/4
```

```
U = R0-G0+255
V = B3-G3+255
```

Here, the U plane in the GUV color space is computed from the particular Green pixels that are co-sited with corresponding Red pixels, which is referred to as `G0` in the above equations. Similarly, the V plane is computed from the particular Green pixels that are co-sited with corresponding Blue pixels; this is referred to above as `G3`. `G0` and `G3` are not the same record. These differences were highlighted in the amended claim 1, at substeps (i) and (ii). Given that Appellant's claims recite an approach that avoids conversion to the (computationally expensive) Y plane by instead deriving a primary channel (G) based on the Green pixels (and not Y, which is based on Red, Green, and Blue pixels), the Examiner's position that Appellant's claim limitation is met by the **Y**CrCb color space described in Acharya (and elsewhere) is unsupported.

A claim is anticipated under Section 102 only if each and every element as set forth in the claim is found, either expressly or inherently described, in the single prior art reference. As Acharya fails to teach each and every element set forth in independent claims 1 and 26 (as well as other claims of this group), Acharya fails to establish anticipation of the claimed invention under Section 102. Accordingly, it is respectfully submitted that the Examiner's rejection of claims of this group is in error and should not be sustained.

B. Rejections under 35 U.S.C. Section 103

1. General

Under Section 103(a), a patent may not be obtained if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which the subject matter pertains. To establish a prima facie case of obviousness under this section, the Examiner must establish: (1) that there is some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings, (2) that there is a reasonable expectation of success, and (3) that the prior art reference (or references when combined) must teach or suggest all the claim limitations. (See e.g., MPEP 2142). The references cited by the Examiner fail to meet these conditions.

2. Group II claims

Claims 7, 11-14, 17, 31, and 35-38 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Acharya (US 6,392,699) in view of Acharya et al. (US 6,348,929). For claims of this group, the Examiner relies on Acharya '699 as substantially teaching the claimed invention (as per the Examiner's rejection under Section 102 above) but then turns to Acharya '929 for teaching Appellant's claim limitation of further compressing an image after the image is transformed into the (recited) second color space.

The claims of this group are believed to be allowable for at least the reasons cited above pertaining to the Examiner's rejection under Section 102, the discussion of which is incorporated into this section by reference. In particular, the claims of this group, which dependent from independent claims 1 and 26, incorporate limitations setting forth an image processing approach that performs partial image processing at the image capture device (e.g., camera) with color interpolation being expressly deferred until after the partially-processed image has been transferred to another device (e.g., "server" computer, as set forth in Appellant's claims). Still further, the claims include additional claim limitations setting forth a color space conversion (GUV color space) that differs markedly from the YCrCb color space cited by the Examiner. Acharya '699 does not teach or suggest these claim limitations. Acharya '929 does not cure this deficiency of Acharya '699 (nor does the Examiner contend as much).

Moreover, the claims are believed to be allowable for the following additional reasons. The newly-added Acharya '929 reference describes image <u>scaling</u>. The operation of "scaling" an image is, within the ordinary usage of that term, one of resizing an image, for example, to make the image bigger (scale "up") or to make the image smaller (scale "down"). (See, e.g., Acharya '929 Background Section, at column 1, lines 40-48.). The Examiner's position is apparently that it is obvious that compression can be added at any point in image processing (e.g., after scaling).

Appellant does not claim to have invented image compression. To be sure, the notion of compressing an image is well established by decades-old prior art. The additional claim limitations of the claims of this group (e.g., Appellant's claim 7) pertain to application of compression technique (which, itself, can be "off-the-shelf" compression) to an image at particular points of image processing (in accordance with Appellate's distributed image processing technique) such as, for example, after it has been mapped to a second color space

(e.g., Appellant's GUV color space). Note, for example, rejected claim 7 describes a technique that undergoes a first compression at the image capture device (i.e., companding step, in base claim 1) and a second compression at the server device (to which the companded image has been transferred). It is respectfully submitted that, in order for the references to render this claim element itself obvious, the combined references should include at least some teaching that describes application of compression methodology at an analogous point in image processing as set forth in Appellant's claims.

Given that the references, even when combined, do not teach or suggest all of Appellant's claim limitations immediately described above (as well as those described under the other rejections), it is believed that the claims of this group set forth a patentable invention. Therefore, it is respectfully submitted that the Examiner's rejection of claims of this group is in error and should not be sustained.

3. Group III claims

Claims 8-10, 23-24, and 32-34 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Acharya (USP 6,392,699) in view of Acharya et al. (USP 6,348,929) further in view of Wang et al. (USP 5,682,152). For claims of this group, the Examiner relies on Acharya '699 and Acharya '929 as substantially teaching the claimed invention (as per the Examiner's first rejection under Section 103 above) but then turns to Wang for teaching Appellant's claim limitation of further compressing an image during image processing using DCT transformation.

The claims of this group are believed to be allowable for at least the reasons cited above pertaining to the deficiencies of Acharya '699 in the Examiner's rejection under Section 102, and additionally the deficiencies are still present (and exacerbated) when combining Acharya '929 in the Examiner's first rejection under Section 103, the discussions of which are incorporated into this section by reference. Briefly recapping, the combined references do not teach or suggest all the claim limitations present in Appellant's rejected claims. In particular, the combination of each subsequent reference only serves to compound, not cure, the deficiencies present in the cited prior art.

Moreover, the claims are believed to be allowable for the following additional reasons. The newly-added Wang reference does not serve to remedy any of the deficiencies noted above pertaining to Acharya '699 and Acharya '929. There is nothing in Wang that

addresses Appellant's claimed feature of deferring color interpolation (at the capture device) until the image is transferred to a server computer. More particularly, the Examiner has cited Wang to buttress Acharya '929 -- that is, that it is obvious to apply compression, and in this instance DCT-based compression. As noted above, Appellant certainly acknowledges that DCT-based compression of images is itself prior art, and Appellant acknowledges as much in the Background Section of the application. (See, e.g., Appellant's specification at p. 5, beginning at line 25.)

The claims do not claim DCT-based image compression in isolation. Instead, the claims describe that the image is partially processed (foregoing color interpolation) and compressed (companded) at the image capture device, subsequently transferred to a server computer where image processing continues with color interpolation, and then DCT-based compression is applied after mapping into a second color space (GUV). Appellant's claims set forth a specific sequence of process steps that affords an image strategy that reduces the processing and the bandwidth resources for digital images (e.g., making them feasible for wireless transmission from a camera-equipped cell phone). The aggregation of otherwise independent elements from the prior art (and which were described in Appellant's Background Section) do not reproduce the sequence of interrelated steps required to reproduce Appellant's invention. It is submitted that the combined references do not establish a prima facie case of obviousness under Section 103. Therefore, it is respectively requested that the Examiner's rejection of claims of this group under Section 103 not be sustained.

4. Group IV claims

Claims 15 and 39 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Acharya (US 6,392,699) in view of Acharya et al. (US 6,348,929) further in view of Fukuoka (US 5,754,227). For claims of this group, the Examiner relies on Acharya '699 and Acharya '929 as substantially teaching the claimed invention (as per the Examiner's first rejection under Section 103 above) but then turns to Fukuoka for teaching Appellant's claim limitation of wireless transmission. The claims of this group are believed to be allowable for at least the reasons cited above pertaining to the deficiencies of Acharya '699 in the Examiner's rejection under Section 102, and additionally the deficiencies still present (and exacerbated) when

combining Acharya '929 in the Examiner's first rejection under Section 103, the discussions of which are incorporated into this section by reference.

Furthermore, the claims are believed to be allowable for the following additional reasons. Note, in particular, that the image that is being transmitted using wireless technique in accordance with Appellant's claims is partially processed (e.g., color interpolation has been deferred). At best, Fukuoka teaches the transmission of an image that has been fully processed. Fukuoka does not provide any teaching analogous to Appellant's deferral of processing (e.g., deferral of interpolation and transformation) as required by Appellant's base claims 1 and 26. Again, the Examiner has cobbled together a loose collection of disparate elements from the prior art without regard to what teaching is actually required to combine the elements in a particular fashion to re-create Appellant's invention. If anything, Fukuoka provides teaching away from Appellant's approach, as Fukuoka describes a system where images are presumed to have been processed at the base device *before* transmission. Certainly, there is no discussion by Fukuoka along the lines of how the image would be transmitted to another device for completion of image processing. Since Fukuoka does not remedy the deficiency of the other references (and if anything injects more doubt into the Examiner's position), the combined references do not teach or suggest all of the claim limitations of Appellant's claims of this group and thus do not establish prima facie obviousness under Section 103. The Examiner's rejection should not be sustained.

5. Group V claims

Claims 16, 18-21, 25 and 40 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Acharya (USP 6,392,699) in view of Acharya et al. (USP 6,348,929) further in view of Rabbani et al. (USP 5,412,427). For claims of this group, the Examiner relies on Acharya '699 and Acharya '929 as substantially teaching the claimed invention (as per the Examiner's first rejection under Section 103 above) but then turns to Rabbani for teaching Appellant's claim limitation of wire-line transmission. The claims of this group are believed to be allowable for at least the reasons cited above pertaining to the deficiencies of Acharya '699 in the Examiner's rejection under Section 102, and additionally the deficiencies still present (and exacerbated) when combining Acharya '929 in the Examiner's first rejection under Section 103, the discussions of which are incorporated into this section by reference.

The claims are believed to be allowable for the following additional reasons. As noted during discussion of Fukuoka, the image that is being transmitted in accordance with Appellant's claimed approach is partially processed at the capturing device -- thus necessitating that Appellant's claimed process incorporate additional elements for completing the image processing. As was the case with Fukuoka, Rabbani at best presumes a completed image. For example, the Examiner states: "However, Rabbani et al. disclose the compressed signals could be downloaded to the personal computer by cable interface (wire-line transmission, column 6, lines 15-20)." (Examiner's Final Action, at paragraph 10.) Rabbani includes no discussion of any subsequent steps occurring at Rabbani's personal computer to finish out image processing that began at an image capture device. Accordingly, it does not provide any teaching analogous to Appellant's approach (e.g., which requires transmission of a partially processed image) as required by Appellant's rejected claims.

The mere aggregation of otherwise disparate elements from the prior art without regard to what teaching is actually required to combine the elements in a particular fashion to re-create Appellant's invention cannot serve as a basis for rejection under Section 103. Rabbani fares no better than Fukuoka at teaching Appellant's approach (and, like Fukuoka, would seem to teach away from Appellant's approach of transmitting partially-processed images). The combined references do not teach or suggest all of the claim limitations of Appellant's claims of this group and thus do not establish prima facie obviousness under Section 103. The Examiner's rejection under this section should not be sustained.

C. Rejection under 35 U.S.C. Section 112, second paragraph

In independent claims 1 and 26, the Examiner has complained about the phrase "co-sited Green pixels." In both claims, the Examiner states that it is not known whether the phrase is referring to the same thing. The rejection is traversed for the reasons discussed below.

First, the two instances of "co-sited Green pixels" do not describe the same thing. Thus to the extent that the Examiner expects the insertion of a "said" or "the" before the second instance, the expectation is misplaced. Second, and perhaps more importantly, the identification of each instance of the "<u>co-sited</u> Green pixels" is abundantly clear from the claim language. For example, in the first usage of the phrase, claim 1 describes "differencing Red pixels with <u>co-sited</u> Green pixels" -- thus, leaving absolutely no doubt that the particular green pixels described are

the ones that are co-sited with the red pixels. Similarly, claim 1 describes "differencing Blue pixels with co-sited Green pixels." And thus it is abundantly clear that the particular green pixels referenced at that point are the ones co-sited with the blue pixels.

Appellant's specification gives very detailed and graphic examples of co-sited pixels -- a concept which by itself is a well-known to those skilled in the image processing art. For example, during the discussion in Appellant specification about the computation of secondary channels (U, V), Appellant presents the equations:

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U = R0-G0+255
V = B3-G3+255
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where R0 is a non-interpolated Red pixel value, G0 is an interpolated Green pixel value (co-sited with R0), B3 is a non-interpolated Blue pixel value, and G3 is an interpolated Green pixel value (co-sited with B3). The actual physical layout of the pixels is illustrated in Appellant's Fig. 6B, which is a block diagram illustrating a well-known Bayer cell (2x2 pattern).

The referenced pixels are not the same and thus it would be inappropriate to include "said" or "the". Further, the purpose of Section 112, second paragraph is to have an applicant particularly point out and distinctly claim the subject matter which the applicant regards as the invention. It is not the purpose of that section to burden claims with additional language that attempts, within the body of the claims themselves, to teach basic tenets of a given art. Appellant's specification includes detailed information about the layout and operation of Bayer cells, which by themselves are already well-known and well-established in the art. The context provided by the claim language leaves no doubt as to what pixels are discussed at each point in the claims. Accordingly, it is respectfully submitted that the rejection is in error and should not be sustained.

9. CONCLUSION:

By exploiting the opportunity to defer and/or distribute the processing of an image between the digital imager itself (e.g., camera) and the target platform that the digital imager will ultimately be connected to (e.g., computer), the present invention provides enabling technology that may form the basis of a new generation of digital cameras that are not only smaller but also

provide improved downloading of images, particularly in a wireless manner. At the same time, Appellant's approach does not impair image quality. It is respectfully submitted that the present invention, as set forth in the pending claims, sets forth a patentable advance over the art.

In view of the above, it is respectfully submitted that the Examiner's rejections under 35 U.S.C. Sections 102, 103, and 112 should not be sustained. If needed, Appellant's undersigned attorney can be reached at (408) 884-1507. For the fee due for this Appeal Brief, please refer to the attached **Fee Transmittal Sheet**. This Brief is submitted in triplicate.

Respectfully submitted,

Date: April 3, 2003

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10. APPENDIX OF CLAIMS ON APPEAL:

1. (Twice Amended) A method for processing image information, the method comprising:

receiving an image in a first color space from an RGB (Red, Green, Blue) mosaic, said image including luminosity values captured at said RGB mosaic, said first color space including primary (Green) and secondary (Red, Blue) channels;

while said image is in said first color space, companding the image by mapping the luminosity values captured at said RGB mosaic into a space that is more linear to a human eye, but deferring any interpolation of pixels until after the companded image has been transferred;

transferring the companded image to a server computer;

storing information describing a second color space, said second color space including primary and secondary channels, said primary channel of said second color space corresponding to the primary channel of said first color space; and

at the server computer, transforming the image into said second color space, including:

interpolating the primary channel of said second color space to full resolution by interpolating missing Green pixels from said RGB mosaic, and

computing the secondary channels of said second color space as differences from the primary channel of said second color, including performing substeps of:

(i) computing one of said secondary channels of said second color space by differencing Red pixels with co-sited Green pixels interpolated from said RGB mosaic, and

(ii) computing the other of said secondary channels of said second color space by differencing Blue pixels with co-sited Green pixels interpolated from said RGB mosaic.

2. The method of claim 1, wherein the primary channel for both said first and said second color spaces comprises predominantly Green (G).

3. The method of claim 2, wherein said first color space comprises an RGB color space and said second color space comprises a GUV color space.

4. The method of claim 1, wherein the secondary channels of the first color space comprise predominantly Red (R) and Blue (B).

5. The method of claim 1, wherein the image is initially captured at a sensor employing an RGB mosaic.

6. The method of claim 5, wherein said sensor employs a mosaic configured as a Bayer pattern.

7. The method of claim 1, further comprising:

after the image is transformed into said second color space, compressing the transformed image.

8. The method of claim 7, wherein said compressing step includes:

compressing the transformed image using transform-based compression.

9. The method of claim 8, wherein said transform-based compression comprises wavelet transform-based compression.

10. The method of claim 8, wherein said transform-based compression comprises DCT- (discrete cosine transformation) based compression.

11. The method of claim 7, wherein said second color space comprises GUV color space having individual G, U, and V planes and said compressing step comprises individually compressing each plane.

12. The method of claim 7, further comprising:

transmitting the compressed, transformed image to a target platform.

13. The method of claim 12, wherein said target platform comprises a computing device.

14. The method of claim 12, wherein said transmitting step includes:

transmitting the compressed, transformed image to a selected one of a desktop computer and a server computer.

15. The method of claim 12, wherein said transmitting step is performed using wireless transmission.

16. The method of claim 12, wherein said transmitting step is performed using wire-line transmission.

17. The method of claim 12, further comprising:

restoring said compressed, transformed image at the target platform to a non-compressed format.

18. The method of claim 17, further comprising:

transforming the non-compressed image into a standard-format color image.

19. The method of claim 18, wherein said standard-format color image comprises a JPEG-formatted color image.

20. The method of claim 17, further comprising:

transforming the non-compressed image into YUV color space.

21. The method of claim 17, further comprising:

transforming the non-compressed image into RGB color space.

22. The method of claim 1, wherein said interpolating step includes applying averaging technique.

23. The method of claim 7, further comprising:

further compressing the image by applying quantization and entropy coding.

24. The method of claim 23, wherein said entropy coding comprises Huffman coding.

25. The method of claim 12, wherein said transmitting step occurs before the primary channel of the second color space is interpreted to full resolution for the image.

26. (Twice Amended) A method for transforming RGB image information into an efficient color space representation, the method comprising:

receiving an image in a first color space from an RGB (Red, Green, Blue) mosaic, said first color space comprising an RGB color space having a primary channel comprising Green (G) and secondary channels comprising Red (R) and Blue (B), said image including luminosity values captured at said RGB mosaic;

while said image is in said first color space, companding the image by mapping the luminosity values captured at said RGB mosaic into a space that is more linear to a human eye, but deferring any interpolation of pixels until after the companded image has been transferred;

transferring the companded image to a server computer;

storing information describing a second color space having primary and secondary channels, said primary channel of said second color space comprising Green (G); and

at the server computer, transforming the image into said second color space, including:

interpolating the primary channel of said second color space to full resolution by interpolating missing Green pixels from said RGB mosaic, and

computing the secondary channels of said second color space as differences from the primary channel of said second color space, by differencing Red pixels with co-sited Green pixels interpolated from said RGB mosaic and differencing Blue pixels with co-sited Green pixels interpolated from said RGB mosaic.

27. The method of claim 26, wherein Green (G) incorporates colors that are substantially green.

28. The method of claim 27, wherein said second color space comprises a GUV color space.

29. The method of claim 26, wherein the image is initially captured at a sensor employing an RGB mosaic.

30. The method of claim 29, wherein said sensor employs a mosaic configured as a Bayer pattern.

31. The method of claim 26, further comprising:

after the image is transformed into said second color space, compressing the transformed image.

32. The method of claim 31, wherein said compressing step includes:

compressing the transformed image using transform-based compression.

33. The method of claim 32, wherein said transform-based compression comprises wavelet transform-based compression.

34. The method of claim 32, wherein said transform-based compression comprises DCT- (discrete cosine transformation) based compression.

35. The method of claim 31, wherein said second color space comprises GUV color space having individual G, U, and V planes and said compressing step comprises individually compressing each plane.

36. The method of claim 31, further comprising:

transmitting the compressed, transformed image to a target platform.

37. The method of claim 36, wherein said target platform comprises a computing device.

38. The method of claim 36, wherein said transmitting step includes:

transmitting the compressed, transformed image to a selected one of a desktop computer and a server computer.

39. The method of claim 36, wherein said transmitting step is performed using wireless transmission.

40. The method of claim 36, wherein said transmitting step is performed using wire-line transmission.

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